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SYMBOL CHARACTER GENERATOR DEVELOPED FOR DECWRITER II

by

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DISCLAIMER

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ABSTRACT

The versatile dot matrix printer of the DECwriter II® was modified to enable printing of symbol characters, e.g., Greek letters and other symbols for mathematical expressions and units of measurement. This development involved the replacement of the read-only memory (ROM) units with erasable-programmable read-only memory (EPROM) units.

INTRODUCTION

Computer terminals typically use the ASCII character set in their printing operation. Scientific applications frequently make use of Greek letters and other symbols for units of measurement. Clarity of communication in many instances requires printing one or two of these symbols in virtually every manuscript. Today's dot matrix terminals can generate nearly any scientific character, provided the proper hardware character generator is available.

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® Tradename of Digital Equipment Corp., Maynard, Mass.

THE DOT MATRIX PRINTER

The versatile dot matrix printer of the DECwriter II consists of a seven-row column which is moved across the paper.[1] Ten column positions are allowed for each character position. Of these ten column positions, the first eight are controlled by the character generator while the last two positions are always blank.

The character generator uses one byte of memory for each column. The most significant bit signifies a printing column, and the other seven bits define the dot pattern. The first byte for printable characters is always 00_{16} for a blank column, while the other seven bytes are determined by the character to be printed. The only constraint on the dot pattern is that no two successive dots may be used in a given row in order to prevent excessive solenoid current draw by the print head. The printer circuitry contains read-only memory (ROM) units to enable printing of Roman letters and Arabic numerals.

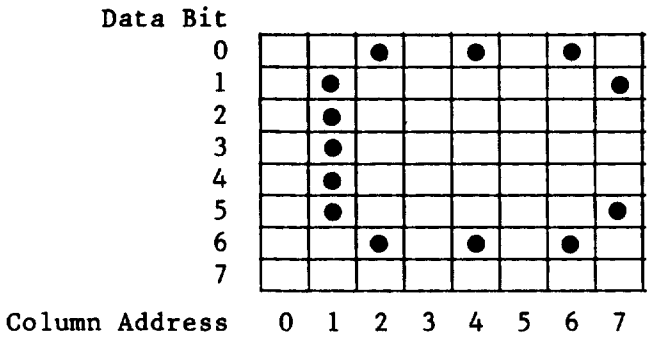
MODIFYING THE PRINTER

Replacing the DECwriter II character generator ROMs with an erasable-programmable read-only memory unit (EPROM) enables the user to have custom printer character capability on the DEC data communications terminal. Each special character requires the sacrifice of a standard ASCII character, but most installations have several unused characters. The replacement of the ROM units with 2716 EPROM units[2] (of 2K capacity) allows two full sets of

characters to be stored, enabling a return to the standard character set by a switch setting. The extra set of characters can be any set of symbols (Cyrillic, algebraic, etc.) that the user desires.

HOW THE MODIFICATION WORKS

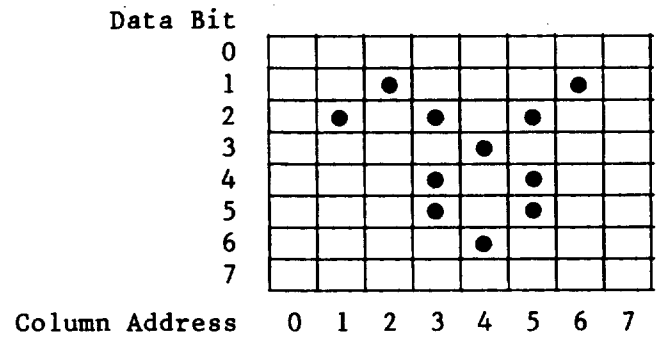
The standard Roman character "C" has the dot pattern shown in Figure 1a. Its EPROM data are shown in Figure 1b. To change the "C" to a Greek gamma (γ) symbol (Figure 2a), the EPROM data are changed to that shown in Figure 2b.



ROM Address	Data
01B8	00
01B9	3E
01BA	41
01BB	00
01BC	41
01BD	00
01BE	41
01BF	22

a. Dot Pattern b. Coded Data

Fig. 1. Standard Character "C" Using ROM Units



EPROM Address	Data
01B8	00
01B9	04
01BA	02
01BB	34
01BC	48
01BD	34
01BE	02
01BF	00

a. Dot Pattern b. Coded Data

Fig. 2. Greek Gamma Symbol Using EPROM Units

The address of a character in the memory is obtained by combining the ASCII code of the character with the column of the character as shown in Figure 3. Since the ASCII code is inverted on the 7728 MPC (microprogramed controller) board in the DECwriter, the character generator ROM starts with a DEL and ends with a NUL.

Name	Parity Error H	$\overline{\text{ASCII7}}$	$\overline{\text{ASCII6}}$	$\overline{\text{ASCII5}}$	$\overline{\text{ASCII4}}$	$\overline{\text{ASCII3}}$	$\overline{\text{ASCII2}}$	$\overline{\text{ASCII1}}$	Col 2	Col 1	Col 0
EPROM Line	$\overline{\text{OE}}$	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0

Fig. 3. Character Address Using EPROM Units

EPROM address line A10 is connected to a switch to allow either half of the EPROM unit to be used as the character generator. Contents of the DEC character generator were determined by clocking a logic analyzer on the Column Increment Counter and reading the ROM input and output lines as each key was struck.* Note that nonprinting characters have ROM codes used by the microprogramed controller. For example, a BEL code starting at address 03C0 is 8F, 8F, 8F, 8F, 8F, 8F, 8F, 8F. Figure 4 is a table of the DEC Mostek 2626 or 2627 ROM pin identifiers versus those for the 2716 EPROM pins.

The active states of the select lines of the DEC ROM chip are factory-programmable. This feature enables these 512-byte ROM units to operate in either Position E48 or Position E53 on the

* Work done by C. L. Wade, and W. J. W. Godbee, E&I Dept., Savannah River Plant, Aiken, S.C.

DEC ROM		2716 EPROM	
Signal Name	Pin	Signal Name	Pin
A8	14	A7	1
A7	15	A6	2
A6	16	A5	3
A5	17	A4	4
A4	18	A3	5
A3	19	A2	6
A2	20	A1	7
A1	21	A0	8
B1	4	O0	9
B2	5	O1	10
B3	6	O2	11
GND	12	GND	12
B4	7	O3	13
B5	8	O4	14
B6	9	O5	15
B7	10	O6	16
B8	11	O7	17
CS3	3	$\overline{CE}$	18
CS2	2*	A10	19
CS1	23	$\overline{OE}$	20
+5	24	+5	21
CS0	22	A9	22
A9	13	A8	23
+5	24	+5	24

* Or SPDT toggle switch.

Fig. 4. ROM Coding vs. EPROM Coding

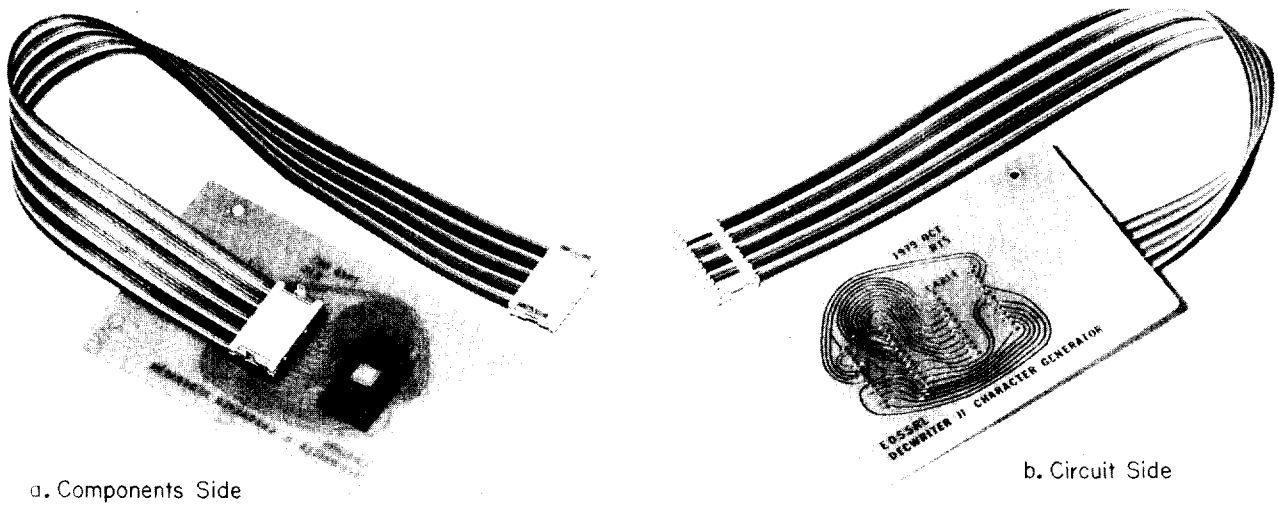
7728 MPC board to produce a 1024-byte character generator. The 2048-byte 2716 EPROM character generator is mounted on a conversion printed circuit board (Fig. 5). The connecting cable is plugged into either ROM socket on the DECwriter II 7728 MPC (Fig. 6).

For someone equipped with a printed circuit facility or WIREWRAP® (Gardner-Denver Co., Grand Haven, Michigan) equipment and an EPROM programer, this modification provides an inexpensive special character option to the DECwriter II. EPROM programing is made simpler by using a microcomputer cross-assembler to set up the data to be programed.

REFERENCES

1. DECwriter II Maintenance Manual LA36/LA35, Digital Equipment Corporation, Maynard, Massachusetts (1976).
2. Intel Component Data Catalog, Intel Corporation, Santa Clara, California (1979).

LIST OF FIGURES



a. Components Side

b. Circuit Side

Fig. 5. Printed EPROM Circuit Board to Replace the ROM Unit in the DECwriter II

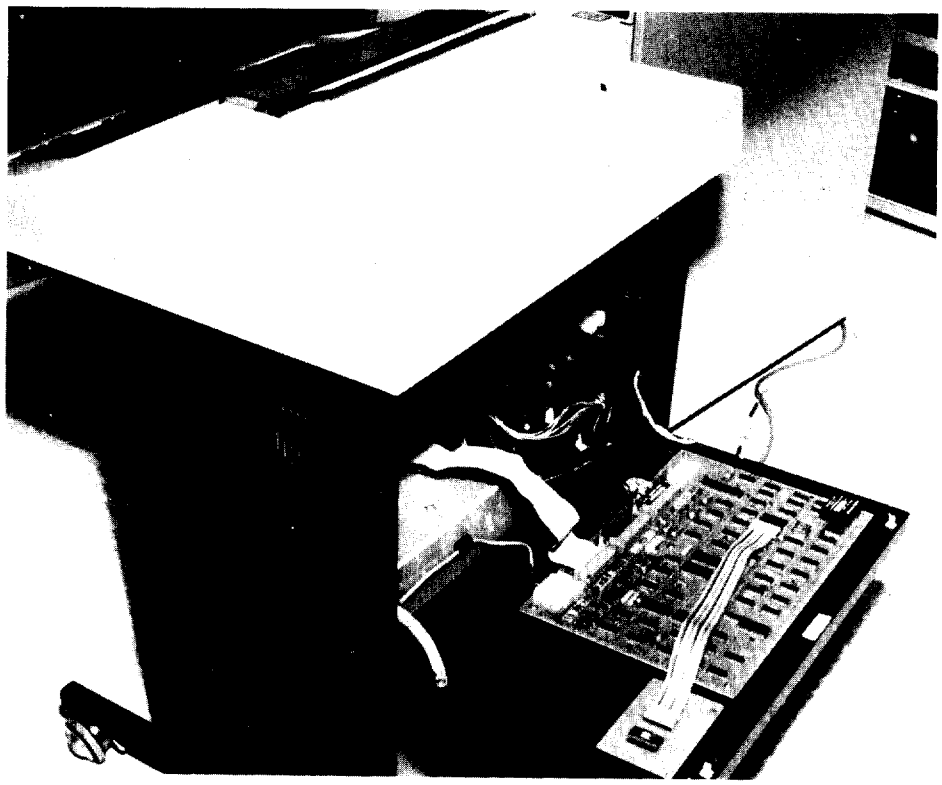


Fig. 6. Conversion Board Mounted in DECwriter II Console